Research on the Current Situation and Trend Development of Engineering Ethics Codes for Civil Engineering

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Abstract. In order to explore how my country's economy can achieve a balance of "the unity of material and self" under the trend of harmonious development of man, nature, and society, a large number of scholars have carried out unremitting exploration and research in their respective fields. However, in the field of civil engineering, especially the analysis of the reasons for the differences in the moral behavior of civil engineers in "creation" activities, and the establishment of ethical standards, a complete system has not yet been formed. As a major infrastructure country, China has the requirements for speed are getting higher and higher, many issues concerning economic and social value considerations have also arisen. Therefore, this article starts from raising the awareness of civil engineers' professional ethical behavior, and reveals its contradictions and complexity by constructing realistic scenes of moral judgment from the perspective of civil engineering industry ethics. It also compares and analyzes the engineering ethics codes of civil engineering disciplines at home and abroad, and puts forward the concept of a new order in the civil engineering industry based on the reality of China, with a view to reducing the "ambiguity" moral dilemma in civil engineering projects.

Keywords: Civil engineering · Engineering ethics code · Civil engineer · Comparative analysis

1 Introduction

The first engineering ethics code in Chinese history can be traced back to 1933 when the Chinese society of civil engineers formulated and promulgated the "*Chinese Society of Engineers Obeying the Rules*". With the relocation of the Chinese Institute of Engineers to Chinese Taipei in 1949, the development of Chinese engineering ethics has diverged. The engineering ethics standards in Taiwan has successfully adjusted to social progress, while in Chinese mainland, the levels of some engineering associations reach

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to some extent, most associations have not yet formulated corresponding engineering ethics standards and only some engineering ethics consciousness have appeared in the tenets of the articles of associations. It was not until the beginning of the 21st century that a few engineering professional societies formulated an engineering ethics code to guide engineers' professional practice [1].

On the whole, the development of engineering ethics in our country is relatively slow. Our country is a veritable engineering construction country, but the development of engineering ethics in our country has not kept pace with the rapid development of the times, and its lag has hindered the development of our country's engineering profession. Therefore, the development status of engineering profession urgently needs to strengthen the attention of engineering ethics, and establish a set of ethics system suitable for the development of our country's engineering profession as soon as possible.

The norms of engineering ethics play an important role in the course of the engineering profession. For example, The United States is one of the countries with the most complete engineering ethics in the world, which is very representative in the development of engineering ethics. Therefore, it is of great significance to discuss the engineering ethics norms suitable for the development of our country, especially the ethics norms in the field of civil engineering, to clarify the professional responsibility of civil engineers and improve the moral quality of civil engineers.

1.1 Engineering Ethics and Professional Ethics

The definition of engineering ethics is still a hot topic in China and abroad. From the perspective of the American engineering community, engineering ethics means that engineers should obey their employers and clients and be honest and reliable in their work. From the perspective of value theory, Chinese scholar Xiao Ping believes that engineering ethics is to explore the social comprehensive value and value relationship behind engineering, and how to promote the realization of these values [2].

The professional ethics of engineers has also been a research issue in engineering ethics and applied ethics. One of the purposes of professional ethics is to provide professionals with detailed professional ethics guidelines to give them better guidance. The Code of Professional Ethics helps Civil Structural Engineers choose how to act when confronted with ethical issues at work, helps clarify values, form a framework for discipline, and build team identity and collaboration. And as an advantage of the engineering profession, it fosters public confidence [3].

Engineering ethics should be systematically advanced to the operation stage. First, engineering ethics should be placed in the professional code of construction activities. Ethical norms can guide engineers to understand and apply their connotations to actual engineering, but the way engineering ethics presented is also very different. Compared with legal provisions, ethical norms are vaguer, and therefore need to be concreted through interpretation. The so-called "ethical interpretation" is the process of specifying the meaning of ethical principles and the concepts and terms used in order to apply them to specific situations and generate value [4]. Faced with the problem of how engineers interpret ethical codes to adapt to current problems and solve them, learning from past engineering cases is the most effective way. Engineering practitioners lacking such local

knowledge are categorically unable to work [5]. This is the main reason why companies need to find local consulting companies or operate through joint ventures when developing abroad. In short, rooted in engineering traditions, legal systems, and cultural traditions, and ethical explanations with the help of relevant case demonstrations, can ethical principles be associated with specific technical actions.

1.2 Civil Engineering Ethics

Civil engineering ethics is subordinate to the category of engineering ethics. On the one hand, it also has the particularity of the meaning of civil engineering, that is, the scientific and technological construction of various engineering facilities such as survey, design, construction, and maintenance under the guidance of national engineering construction regulations [6]. On the other hand, it contains the common characteristics of engineering ethics, that is, the use of ethical theories to carry out moral judgments in engineering field activities.

This paper argues that when it is related to civil engineering activities, civil engineering ethics is the use of ethical theories to explain various ethical decisions and ethical value judgments in the civil engineering industry, to study the professional ethical behavior of the main body of civil engineering activities, and to formulate ethical standards for the civil engineering industry. It includes various responsibility specifications for the public, employers, clients, colleagues, and professions, safety specifications for considering the safety of engineering construction design and the impact on the environment and ecology, and risk specifications for preventing possible project construction risks. Ethical norms and operational order of the civil engineering industry, value demands and professional positions of different interest groups, etc.

2 The Development and Current Situation of Civil Engineering Ethics

Not everything that is technically feasible is morally acceptable, and ethical issues emerge as technology progresses. To balance and deal with increasing cost pressures, responsibility to society, and responsibility for building defects and damage, civil and structural engineers need ethically impeccable codes of professional conduct that are not influenced by the interests of their stakeholders [7]. Usually, a code of ethics or code of conduct for civil or structural engineers is a rule set by an organization of engineers or a professional association of engineers. The author selects the ethical standards of the Society of Civil Engineers, which is represented by the long history of engineering ethics in the capitalist countries of the United States and the United Kingdom, and analyzes it. Get valuable advice on the development of engineering ethics in China.

2.1 Development and Current Situation of Civil Engineer Associations at Home and Abroad

2.1.1 The United States

The American Society of Civil Engineering was established in 1852. ASCE, as the earliest National Society of Engineers in the United States, has a strong representation of

the early exploration of engineering ethics. ASCE was founded in an attempt to establish "a recognized professional role" and use their social identity "to demonstrate to potential employers that they have a minimum level of competence" and are constantly looking for ways to build their professional honors. In order to make their societies "elite organizations", they have taken a series of actions: setting strict and high standards for membership, and stipulating that only well-known and successful engineering practitioners can join the society, and ASCE aims to establish professional honors, there was some initial informal discussion on the development of ethical norms [8].

According to the ASCE Bylaws, all ASCE members are required to comply with the "Code of Ethics" and report any violations identified. The Professional Conduct Committee (CPC) reviews and investigates complaints in accordance with its rules of procedure. If the CPC finds a violation of the "Code of Ethics" and appropriate disciplinary action is taken, it will forward its recommendation to the ASCE Executive Committee or Steering Committee for a formal hearing on the matter [9]. Members of the American Society of Civil Engineers act with integrity and professionalism, and most importantly, to protect and enhance the health, safety, and well-being of the public through the practice of civil engineering. With the continuous development of engineering activities, the negative impact of engineering on the environment is increasing. Due to these pressures, ASCE took the lead in revising the code in 1977, and for the first time stated that "engineers should be obliged to improve the environment to improve our quality of life" Included. However, in this clause, the compulsion of the clause and the enforcement of the clause are weakened. Through revision, the 1996 Code of Ethics included more environmental terms, and the terms involved in the environment became "must", and if engineers did not advance their work with this attitude, they would be violating the Code of Ethics, and therefore punished. The 2006 "code of ethics" added zero tolerance for bribery, corruption, and fraud to the seven basic principles, and clarified engineers' responsibilities for integrity in gray areas. In July 2017, ASCE further

Table 1. Development and Changes of the Fundamental Principles of the American ASCE Code of Ethics

Time	fundamental principles
2017	1. Using their knowledge and skill for the enhancement of human welfare and the environment
	2. Being honest and impartial and serving with fidelity the public, their employers and clients
	3. Striving to increase the competence and prestige of the engineering profession
	4. Supporting the professional and technical societies of their disciplines
2020	1. Create safe, resilient, and sustainable infrastructure;
	2. Treat all persons with respect, dignity, and fairness in a manner that fosters equitable participation without regard to personal identity
	3. Consider the current and anticipated needs of society
	4. Utilize their knowledge and skills to enhance the quality of life for humanity

revised the "code of ethics", including four basic principles and seven basic guidelines, and added a guideline to the practical guide. In 2020, the four basic principles of the code of ethics have been added and revised, considering that engineers should improve the quality of human life and other high-level goals, meet current social needs, and contribute to the beautiful development of society, as shown in Table 1.

2.1.2 The United Kingdom

The British Institution of Civil Engineers was founded in England in 1818 and was chartered by the Royal Charter in 1828, making civil engineering officially recognized as a profession. As an international professional engineering institution with a long history, ICE has both academic exchange and professional qualification certification functions. ICE members from all over the world are engaged in work related to the construction industry, and at all times abide by the society's professional code of conduct and maintain professional ethics and professionalism [10]. In order to promote the sustainable development of the civil engineering profession and promote the continuous development of professional ethics standards, the British Institution of Civil Engineers has continuously revised and adopted the ICE "Code of Professional Conduct", which contains specific rules and ethical behaviors that members must abide by, as shown in Table 2.

2.1.3 China

The Chinese Society of Civil Engineers was established in 1912. Its predecessor was the Chinese Institution of Engineers, founded by Zhan Tianyou, a modern Chinese civil engineer [11]. The Chinese Society of Civil Engineers and the Chinese Institution of Engineers are the relationship between the branch and the general meeting. The Chinese Institution of Engineers is committed to promoting the development of engineering in my country.

With the continuous development of society, the Chinese Institution of Engineers has gradually realized the important impact of engineers' professional activities on society. In order to restore my country's inherent morality, referring to the precedents of other countries, members of the Institution of Engineers began to formulate engineering ethics standards [12].

The 1933 "Chinese Society of Engineers Obeying the Rules" is the earliest engineering ethics code written in the history of our country. From its content, it can be seen that the responsibility objects of engineers in this period are mainly employers or customers, colleagues and occupations. In 1941, the 10th annual meeting of the Chinese Society of Engineers passed an amendment to rename the "Chinese Society of Engineers Obeying the Rules" as "China's Engineers Creed", which increased the responsibility of engineers to the country and the nation, and revised the content of the original regulations, which reflected Out of a certain period of national political color [13]. In 1996, the "Chinese Engineer Creed" was revised again, which has been used to this day and provides guidelines for engineers in their professional activities.

Compared with the previous creeds, the 1996 creed has a richer influx of responsibility and basically covers all the points of today's engineering ethics. It not only emphasizes the responsibility of engineers to their profession and employers, but also

Table 2. ICE Code of Professional Conduct (2017)

Time	THE RULES OF PROFESSIONAL CONDUCT
2017	1.All members shall discharge their professional duties with integrity and shall behave with integrity in relation to all conduct bearing upon the standing, reputation and dignity of the Institution and of the profession of civil engineering.
	2.All members shall only undertake work that they are competent to do.
	3.All members shall have full regard for the public interest, particularly in relation to matters of health and safety, and in relation to the well-being of future generations
	4.All members shall show due regard for the environment and for the sustainable management of natural resources
	5.All members shall develop their professional knowledge, skills and competence on a continuing basis and shall give all reasonable assistance to further the education, training and continuing professional development of others
	6.Others (felony, bankruptcy, no longer as a company director, discovery of others violating the code of professional conduct, the association should be notified promptly)

puts engineers' social responsibility and environmental awareness first. One, the 1996 creed has been synchronized with the mature, institutionalized engineering ethics codes in the world today. In order to make the 1996 creed more operational, the Chinese Institution of Engineers also formulated the "Detailed Rules for the Implementation of the Chinese Engineer Creed", which further detailed and specified the ethical responsibilities of engineers in the four aspects of the 1996 creed [14]. So far, the development of the engineering ethics norms of the Chinese Society of Engineers has gradually become more complete, and has experienced the evolution process from employers, customers to the country, nation, and then to the public and the environment, making the Chinese Society of Engineers become an engineer group that lives up to the trust of the society [15], as shown in Table 2.

The Chinese Institution of Engineers has also made great progress in the development of engineering ethics education, methods and other aspects. The Chinese Society of Engineering Education promulgated the "Engineering and Education Accreditation Specifications" to actively promote engineering education and engineering accreditation. At present, China has become a formal member of the Washington Accord (WA). In addition, engineering ethics education has become a general education curriculum in various universities. With the opening up of society, people in the engineering community in Taiwan have gradually begun to pay attention to public interests, but the self-aggregation or self-discipline function of the members of the society is still weak, and the ethical supervision or self-discipline mechanism of the professional community has not yet been established. Many engineers fail to interpret or practice these tenets. To this end, in the White Paper on the 110-Year Development Strategy of the Chinese Society of Engineers, the Chinese Society of Engineers launched four action plans to

Table 3. Engineer's Creed Implementation Rules

Classification of Engineer Responsibilities	specific principles
Responsibility to Society	Law-abiding and dedication - abide by laws and regulations, protect public safety, and improve people's well-being
	Respect for nature - maintain ecological balance, cherish natural resources, and preserve cultural assets
Responsibility to the profession	Dedication and Observance - Give full play to professional skills, strictly abide by professional duties, and do a good job in engineering practice
	Innovation and improvement - absorb new knowledge of science and technology, strive for improvement, and improve product quality
Responsibilities to Employers	Sincere service - do your best to provide the best service and achieve work goals
	Mutual trust and mutual benefit - build mutual trust, create a win-win consensus, and create outstanding engineering achievements
Responsibility to Colleagues	Division of labor and cooperation - implement the division of expertise, focus on coordination and cooperation, and improve operational efficiency
	Inheriting the past and linking the future - determined to encourage and encourage each other, inherit technical experience, and cultivate backward talents

promote the development of the engineering ethics system and ultimately establish an ethical engineering environment [16] (Table 3).

2.2 Comparative Analysis of Professional Ethics Guidelines of Civil Engineer Associations at Home and Abroad

The code of engineering ethics has developed into a standard and activity guide for engineers' professional behavior, and determines the level of engineering professional development. The formulation and improvement of these ethical norms not only promote the improvement of the professional ethics level of engineers, but also promote the process of engineering professional development. By classifying and sorting out the above-mentioned certification standards for engineering ethics by professionals of relevant civil engineering associations in developed countries in Europe and the United States, it can be found that there are some similarities and differences in engineering ethics norms.

Compared with the engineering ethics norms in Europe and the United States and other countries and regions, my country's engineering ethics norms are generally more traditional, conservative and lagging behind, and the engineering community has not formed a complete and systematic ethical norms system, but only a superficial and vague general expression, lacking a macroscopic guidelines, operating principles and practical standards.

The current engineering ethics codes have different manifestations in terms of structure. The engineering ethics norms of developed countries such as Europe and the United States have developed into three structures and systems: one is a short contract type, the second is a long and detailed type, and the third is a basic principle + basic clause type. This structural form is adopted by most professional societies. For example, the 2017 ASCE Engineering Ethics Code consists of 4 basic principles and 7 basic clauses, with only 209 words. Because ASCE vigorously enforces its code, every clause is passed. The current five engineering ethics codes in mainland China, except for the "Code of Ethics for Practitioners in Engineering Survey and Geo-technical Engineering Industry" which adopts the form of basic principles and basic clauses, the remaining four all use a few simple rules to regulate the professional behavior of engineers. The content is very concise [17].

In terms of content, the current engineering ethics code basically covers three major aspects of the engineer's responsibilities, namely, the responsibility to the society and the public; the responsibility to the employer and the customer; and the responsibility to the profession. The process of analyzing and sorting out "CODE OF EITHICS" in ASCE will be explained. ASCE sets ethical standards for member engineering from five aspects: responsibility to society, responsibility to the natural and built environment, responsibility to the profession, responsibility to employers and customers, and responsibility to colleagues. The ICE CODE OF PROFESSIONAL CONDUCT of the British Institute of Civil Engineers includes a preamble, basic clauses, and an action guide, which stipulates the members' engineering ethics responsibilities from six aspects. Basic terms are basic and abstract guidance; action guidelines are specific behavioral standards of ethical norms. The Chinese Society of Civil Engineers does not have a special code of engineering ethics, and continues to use the "Chinese Engineer Creed" issued by the Chinese Society of Engineers in 1996, which divides the responsibilities of engineers into four categories: social responsibility, professional responsibility, employer responsibility and colleagues' responsibilities.

The current engineering ethics norms in the UK and the US, on the one hand, have undergone a long period of revision and use, and have been constantly advancing with the times to update the norms to better suit modern society; It has strong executive power and can basically guide the professional behavior of engineers [18]; while China's current engineering ethics code has only been developed for more than ten years, there is no continuous revision to keep pace with the times, and the content is very concise and has a weak executive power (Table 4).

Table 4. Engineering Ethics Standards Comparison

ASCE	ICE	CIE
basic principle + basic clause type	long and detailed type	short contract type
Responsibility to Society; to Nature and Built Environment; to Profession; to Employers and Clients; to Colleagues	Responsibility to Society; to Nature Environment; to Profession; to profession; others	Responsibility to Society; to the profession; to Employers; to Colleagues
2020	2017	1996

3 Suggestions for Development of Civil Engineering Ethics in China

The supply of engineering ethics codes for civil engineering majors in China is seriously insufficient and far from enough to deal with the current situation. Currently, the engineering ethics codes of China Survey and Design Association are applicable to a wide range of people, including not only engineers but also other personnel, and the engineering ethics standards related to civil engineering majors are even more rare [19]. Therefore, it is necessary to formulate engineering ethics codes suitable for civil engineering majors to improve the moral quality and ethical awareness of civil engineering engineers. Secondly, due to the existence of a certain scope of engineering ethics, each country's engineering ethics should consider its specific customs and ethical requirements, but in today's globalization context, engineering has spread to a larger field. International cooperation is the general trend, and extensive cooperation between my country and international engineering ethics standards organizations should be strengthened to improve the internationalization and standardization of civil engineering professional ethics.

Furthermore, both domestic and foreign engineering ethics norms have their own ambiguities and uncertainties, which will inevitably lead to their high generality, which cannot clearly define the connotation and extension, and must be supplemented according to specific circumstances. In short, it is necessary to be rooted in engineering traditions, legal systems and cultural traditions, and to explain ethical principles with the help of relevant case demonstrations, in order to embed ethical principles into specific engineering and technical activities.

4 Conclusion

By comparing the code of ethics for civil engineering in the above three countries, the supply of engineering ethics codes for civil engineering majors in China is seriously insufficient and far from enough to deal with the current situation. Engineering ethics should be systematically advanced to the operation stage, and more researchers should pay much more attention to it.

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